

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: ELECTRICAL ENGINEERING

SUBJECT NAME: SMART GRIDS

SUBJECT CODE: 3710717

M.E. 1st SEMESTER

Type of course: Program Elective I

Prerequisite:

Rationale: Due to recent developments in Information and Communication Technology, it has become possible to monitor and control the electrical utility grids in more efficient, fast, accurate and effective manner. This subject deals with the basic concepts related to smart grids and micro grids.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	<ul style="list-style-type: none">• Introduction to Smart Grid, Evolution of Electric Grid• Concept of Smart Grid, Definitions• Need of Smart Grid, Concept of Robust & Self Healing Grid• Present development & International policies in Smart Grid	8	20
2	<ul style="list-style-type: none">• Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading(AMR)• Outage Management System(OMS)• Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation• Smart Substations, Substation Automation, Feeder Automation	8	15
3	<ul style="list-style-type: none">• Geographic Information System(GIS)• Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS)• Phasor Measurement Unit(PMU)	8	15
4	<ul style="list-style-type: none">• Concept of micro-grid, need & applications of micro-grid, formation of micro-grid, Issues of interconnection, protection & control of micro-grid.• Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel-cells, micro-turbines• Captive power plants, Integration of renewable energy sources	8	20
5	<ul style="list-style-type: none">• Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources• Power Quality Conditioners for Smart Grid, Web based Power• Quality monitoring	6	15

	<ul style="list-style-type: none"> • Power Quality Audit 		
6	<ul style="list-style-type: none"> • Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN) • Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, • Wireless Mesh Network, Basics of CLOUD Computing & Cyber Security for Smart Grid • Broadband over Power line (BPL) • IP based protocols 	6	15

Reference Books:

- Ali Keyhani, “Design of smart power grid renewable energy systems”, Wiley IEEE, 2011
- Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press , 2009
- Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, “Smart Grid: Technology and Applications”, Wiley 2012
- Stuart Borlase, “Smart Grid: Infrastructure, Technology and solutions “ CRC Press
- A.G.Phadke, “Synchronized Phasor Measurement and their Applications”, Springer

Course Outcome:

Students will be able to:

1. Appreciate the difference between smart grid & conventional grid
2. Apply smart metering concepts to industrial and commercial installations
3. Formulate solutions in the areas of smart substations, distributed generation and wide area measurements
4. Come up with smart grid solutions using modern communication technologies

List of Experiments:

- Practicals based on above topics

Major Equipment:

List of Open Source Software/learning website:

- E-materials available at the website of NPTEL- <http://nptel.ac.in/>